Summary Abstract: Band offsets at HgTe CdTe interfaces

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Band offsets are an important physical characteristic of any heterojunction. The HgTe-CdTe offset is particularly important since it affects the properties of the superlattice which is under much investigation theoretically and experimentally.[1,2] To measure band offsets an abrupt interface is necessary, requiring limited interdiffusion between each material. This requires a low temperature technique to grow a HgTe epitaxial layer on CdTe. Conventional Te-rich liquid-phase epitaxy (LPE) has too much interdiffusion for a meaningful measurement. Metal–organic chemical vapor deposition (MOCVD) which can be done at 325 °C possibly has too much interdiffusion.[3] Up until now the lowest temperature growth technique has been molecular beam epitaxy (MBE) which grows in the range 120–200 °C with best epitaxy near 200 °C.[4] Below is a description of a novel Hg-rich LPE technique which also gives growth in the range 125–200 °C.

The Hg-rich LPE technique consists of cleaving a CdTe crystal in a Hg melt supersaturated with Te. Growth then takes place on the freshly cleaved (110) planes. Growth has been achieved for cleaving temperatures in the range 125–200 °C. The HgTe epitaxial layer is always striated typically consisting of adjoined crystals approximately 1 μm wide by 1 μm thick and often 100 μm long aligned along the $[\bar{1}10]$ direction. The growth tends to nucleate at steps in the cleavage plane. The grown layers have been chemically analyzed using EDAX and were found to be HgTe within the limits of this technique. The crystallinity has been investigated using double-crystal x-ray diffraction. Rocking curves show the appearance of a satellite peak which would correspond to the epitaxial HgTe layer which has a 0.3% lattice mismatch with the substrate. Investigations using ion channeling are in progress.

Electrical measurements consisting mainly of *I-V* measurements are still in progress. The *I-V* measurements are being interpreted using thermionic emission over barriers modelled using a self-consistent Poisson equation solution. The barrier height that we would expect to measure is found to be dependent on the amount of doping in *n*-type CdTe as well as whether the HgTe is *n* type or *p* type. Preliminary measurements of barrier heights of HgTe on *n*-type CdTe show agreement with measurements made by Kuech and McCaldin of MOCVD grown HgTe on CdTe who found a barrier height in the range 0.7–0.9 eV depending on the CdTe doping.[3] Analyzing this system with the above model, if a 0 eV valence band offset is assumed,[1,5] a barrier height of about 1.3 eV would be expected. The difference could be due to interdiffusion or defects which could lower the barrier. It is expected that diffusion can be ruled out in structures grown by this novel LPE technique. Results and details of the growth will be published elsewhere.

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